Longitudinal Wave Spring

P7-1500-01

INSTRUCTIONAL GUIDE

Contents

- Metal spring with holder
- Banana plug connector
- Allen Key

Required for activity:

- Sine Wave Generator (P7-2000)
- Mechanical Wave Driver (P7-1000)
- Ring Stand (66-4220)

Background

Longitudinal standing waves are common in many different mediums; gases liquids and solids. When a wave train moves through a medium and encounters an end or boundary, some portion of the wave energy will be reflected backward. If the original source of the waves continues, the medium will quickly fill with waves traveling back and forth over each other. At specific frequencies the displacements of these waves will combine to produce a steady-state interference called a standing wave. If the disturbance is produced in a long spring by a back and forth displacement in the same direction of the spring, the coils will be compressed and stretched producing a longitudinal standing wave.

Activity

Set-Up:

1. Attach the banana plug connector to the spring by hooking one end of the spring through the hole in the plug.
2. Insert the banana plug into the shaft of the Mechanical Wave Driver.
3. Attach the other end of the spring to a ring stand clamp. Raise the clamp, stretching the spring upward 40-50 cm. To quantify the tension of the spring, a Digital Newton Meter (01-7000) may be added between the spring and clamp.
4. Connect the Mechanical Wave Driver to a Sine Wave Generator.

With the amplitude of the Sine Wave Generator turned low, turn on the generator, starting with a low frequency of about 5 Hz output to Mechanical Wave Driver. Increase the amplitude and gradually increase the frequency until nodes and antinodes form along the spring.

The nodes will appear where sections of the spring appear motionless while the antinodes appear as a blurred agitation. Measuring the spacing from node to node or antinode to antinode will give a value equal to half the wavelength of the standing wave. Recall that speed is distance over time:

$$speed = \frac{distance}{time}$$

Waves also have properties of distance (wavelength) and time (frequency). Therefore, we can determine the speed of a wave with a simple equation. Write the formula for wave speed (*v*) in terms of wavelength and frequency. Remember that frequency has units of *1/s*.

$$v = \lambda \cdot f$$

Try increasing the frequency of the generator until the next standing wave pattern forms on the spring and notice how the spacing pattern changes. With this new spacing and frequency, again calculate the wave speed as above and compare it to your first calculation.

Related Products

Mechanical Wave Accessories Bundle (P7-1500) The Arbor Scientific Mechanical Wave Accessories Bundle makes harmonic and motion demonstrations affordable for ALL Physics classrooms.

Digital Signal Generator (P6-8080) The digital signal generator provides a continuous signal sweep from 0.1Hz to 100kHz via fast change buttons and fine adjust, this eliminates the need for switching ranges.

Spring Wave (P7-7220) Use this highly visible Spring Wave to observe phase reversal at the fixed end of wave pulses and to test fundamental and multiple vibrations.